a. generating at least one laser pulse which has a pulse width equal to or less than said characteristic laser pulse width; and

b. directing said pulse to a point above the surface of the material.

2 102. (Added) The method according to claim 101, wherein the material is a metal, the pulse width is 10 to 10,000 femtoseconds, and the pulse has an energy of 1 nanojoule to 1 microjoule.

3 103. (Added) The method according to claim 101, wherein the spot size is varied within a range of 1 to 100 microns by changing the of number of the laser beam.

4 104. (Added) The method according to claim 101, wherein the spot size is varied within a range of 1 to 100 microns by varying the target position.

B1 cont 5 105. (Added) The method according to claim 101, wherein the material is transparent to radiation emitted by the laser and the pulse width is 10 to 10,000 femtoseconds, the pulse has an energy of 10 nanojoules to 1 millijoule.

6 106. (Added) The method according to claim 101, wherein the step of focusing directs the focus of the beam to a point above the surface.

7 107. (Added) A method for laser induced breakdown (LIB) of a material with a pulsed laser beam, the material being characterized by a relationship of fluence breakdown threshold versus laser pulse width that exhibits a rapid and distinct change in slope at a predetermined laser pulse width where the onset of plasma induced breakdown occurs, said method comprising the steps of:

a. generating a beam of one or more laser pulses in which each pulse has a pulse width equal to or less than said predetermined laser pulse width obtained by determining the ablation (LIB) threshold of the material as a function of pulse width and

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by determining where the ablation (LIB) threshold function is no longer proportional to the square root of pulse width; and

b. focusing said beam to a point above the surface of the material so that the ablation threshold of said beam is substantially at said surface.

8 ~~108~~. (Added) The method according to claim ~~101~~ 1, wherein the laser pulse has an energy in a range of 10 nanojoules to 1 millijoule.

9 ~~109~~. (Added) The method according to claim ~~101~~ 1, wherein the laser pulse has a fluence in a range of 100 millijoules per square centimeter to 100 joules per square centimeter.

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10 ~~110~~. (Added) The method according to claim ~~101~~ 1, wherein the laser pulse defines a spot in or on the material and the LIB causes ablation of an area having a size smaller than the area of the spot.

11 ~~111~~. (Added) The method according to claim ~~101~~ 1, wherein the laser pulse has a wavelength in a range of 200 nanometers to 2 microns.

12 ~~112~~. (Added) The method according to claim ~~101~~ 1, wherein the pulse width is in a range of a few picoseconds to femtoseconds.

13 ~~113~~. (Added) The method according to claim ~~101~~ 1, wherein the breakdown includes changes caused by one or more of ionization, free electron multiplication, dielectric breakdown, plasma formation, and vaporization.

14 ~~114~~. (Added) The method according to claim ~~101~~ 1, wherein the breakdown includes plasma formation.

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15 115. (Added) The method according to claim 1 ~~101~~, wherein the breakdown includes disintegration.

16 116. (Added) The method according to claim 1 ~~101~~, wherein the breakdown includes ablation.

17 117. (Added) The method according to claim 1 ~~101~~, wherein the breakdown includes vaporization.

18 118. (Added) The method according to claim 1 ~~101~~, wherein the spot size is varied by flexible diaphragm to a range of 1 to 100 microns.

19 119. (Added) The method according to claim 1 ~~101~~, wherein a mask is placed in the path of the beam to block a portion of the beam to cause the beam to assume a desired geometric configuration.

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20 120. (Added) The method according to claim 1 ~~101~~, wherein the laser operating mode is non-TEMoo.

21 121. (Added) The method according to claim 1 ~~101~~, wherein the laser pulse defines a spot and has a lateral gaussian profile characterized in that fluence at or near the center of the pulse spot is greater than the threshold fluence whereby the laser induced breakdown is ablation of an area within the spot.

22 122. (Added) The method according to claim 21 ~~121~~, wherein the spot size is a diffraction limited spot size providing an ablation cavity having a diameter less than the fundamental wavelength size.

23 123. (Added) The method according to claim 1 ~~101~~, wherein the characteristic pulse width is obtained by determining the ablation (LIB) threshold of the material as a

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function of pulse width and determining where the ablation (LIB) threshold function is no longer proportional to the square root of pulse width.

24 ~~124~~. (Added) A method for laser induced breakdown of a material which comprises:

a. generating a beam of one or more laser pulses in which each pulse has a pulse width equal to or less than a pulse width value corresponding to a change in slope of a curve of fluence breakdown threshold (Fth) as a function of laser pulse width (T), said change occurring at a point between first and second portions of said curve, said first portion spanning a range of relatively long pulse width where Fth varies with the square root of pulse width (T1/2) and said second portion spanning a range of short pulse width relative to said first portion with a Fth versus T slope which differs from that of said first portion; and

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b. directing said one or more pulses of said beam to a point above the surface of the material.

25 ~~125~~. (Added) The method according to claim 24 ~~124~~ and further including:

a. identifying a pulse width start point;

b. directing the laser beam initial start point above the surface of the material; and

c. scanning said beam along a predetermined path in a transverse direction.

26 ~~126~~. (Added) The method according to claim 24 ~~124~~ and further including:

a. identifying a pulse width start point;

b. directing the laser beam initial start point above the surface of the material; and

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c. scanning said beam along a predetermined path in a longitudinal direction in the material to a depth smaller than the Rayleigh range.

27 ~~127~~. (Added) The method according to claim ~~124~~ 24, wherein the breakdown includes changes caused by one or more of ionization, free electron multiplication, dielectric breakdown, plasma formation, and vaporization.

28 ~~128~~. (Added) The method according to claim ~~124~~ 24, wherein the breakdown includes plasma formation.

29 ~~129~~. (Added) The method according to claim ~~124~~ 24, wherein the breakdown includes disintegration.

B1 30 ~~130~~. (Added) The method according to claim ~~124~~ 24, wherein the breakdown includes ablation.

Cont 31 ~~131~~. (Added) The method according to claim ~~124~~ 24, wherein the breakdown includes vaporization.

32 ~~132~~. (Added) The method according to any one of claims ~~101~~ 1, ~~102~~ 2, ~~105~~ 5 or ~~124~~ 24, wherein said beam is obtained by chirped-pulse amplification (CPA) means comprising means for generating a short optical pulse having a predetermined duration;

means for stretching such optical pulse in time;

means for amplifying such time-stretched optical pulse including solid state amplifying media; and

means for recompressing such amplified pulse to its original duration.

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33 ~~133~~. (Added) A method for laser induced breakdown (LIB) of a non-organic material with a pulsed laser beam, the material being characterized by a relationship of fluence threshold at which breakdown occurs versus laser pulse width that exhibits a distinct change in slope at a predetermined laser pulse width where the onset of plasma induced breakdown occurs, said method comprising the steps of:

a. generating at least one laser pulse which has a pulse width equal to or less than said predetermined laser pulse width; and

b. directing said pulse to a point above the surface of the material so that the laser beam defines a spot and has a lateral gaussian profile characterized in that fluence at or near the center of the beam spot is greater than the threshold fluence whereby the laser induced breakdown is ablation of an area within the spot.

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34 ~~134~~. (Added) The method according to claim 33 ~~133~~, wherein the spot size is a diffraction limited spot size providing an ablation cavity having a diameter less than the fundamental wavelength size.

35 ~~135~~. (Added) A method for laser induced breakdown (LIB) of a non-biologic material with a pulsed laser beam, the material being characterized by a relationship of fluence threshold at which breakdown occurs versus laser pulse width that exhibits a distinct change in slope at a predetermined laser pulse width where the onset of plasma induced breakdown occurs, said method comprising the steps of:

a. generating at least one laser pulse which has a pulse width equal to or less than said predetermined laser pulse width; and

b. directing said pulse to a point above the surface of the material the pulse width is 10 to 10,000 femtoseconds and the beam has an energy of 10 nanojoules to 1 millijoule.

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36 ~~136~~. (Added) A method for laser induced breakdown (LIB) of a material by plasma formation with a pulsed laser beam, the material being characterized by a relationship of fluence threshold at which breakdown occurs versus laser pulse width that exhibits a distinct change in slope at a characteristic laser pulse width, said method comprising the steps of:

a. generating at least one laser pulse which has a pulse width equal to or less than said characteristic laser pulse width, said characteristic pulse width being defined by the ablation (LIB) threshold of the material as a function of pulse width where the ablation (LIB) threshold function is no longer proportional to the square root of pulse width; and

b. directing said pulse to a point above the surface of the material and inducing breakdown by plasma formation in the material.

B1 37 ~~137~~. (Added) A method for laser induced breakdown of a material which comprises:

Cont a. determining, for a selected material, characteristic curve of fluence breakdown threshold (Fth) as a function of the square root of laser pulse width;

b. identifying a pulse width value on said curve corresponding to a distinct change in the relationship between the fluence breakdown and the square root of pulse width characteristic of said material;

c. generating a beam of one or more laser pulses, said pulses having a pulse width at or below said pulse width value corresponding to said distinct change in slope; and

d. directing said one or more pulses of said beam to a point above the surface of the material.

38 ~~138~~. (Added) The method according to claim ~~137~~ 37 and further including:

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a. identifying a pulse width start point;

b. directing the laser beam initial start point above the surface of the material; and

c. scanning said beam along a predetermined path in a transverse direction.

39 ~~139~~. (Added) The method according to claim ~~137~~ 37 and further including:

a. identifying a pulse width start point;

b. directing the laser beam initial start point above the surface of the material; and

c. scanning said beam along a predetermined path in a longitudinal direction in the material to a depth smaller than the Rayleigh range.

B1 cont

40 ~~140~~. (Added) The method according to claim ~~137~~ 37, wherein the breakdown includes changes caused by one or more of ionization, free electron multiplication, dielectric breakdown, plasma formation, and vaporization.

41 ~~141~~. (Added) The method according to claim ~~137~~ 37, wherein the breakdown includes plasma formation.

42 ~~142~~. (Added) The method according to claim ~~137~~ 37, wherein the breakdown includes disintegration.

43 ~~143~~. (Added) The method according to claim ~~137~~ 37, wherein the breakdown includes ablation.

44 ~~144~~. (Added) The method according to claim ~~137~~ 37, wherein breakdown includes vaporization.

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45 ~~145~~. (Added) The method according to any one of claims ~~135~~ 35 or ~~137~~ 37, wherein said beam is obtained by chirped-pulse amplification (CPA) means comprising means for generating a short optical pulse having a predetermined duration;

means for stretching such optical pulse in time;

means for amplifying such time-stretched optical pulse including solid state amplifying media;

and means for recompressing such amplified pulse to its original duration.

46 ~~146~~. (Added) A method for laser induced breakdown (LIB) of a metallic material with a pulsed laser beam, the material being characterized by a relationship of fluence threshold at which breakdown occurs versus laser pulse width that exhibits a distinct change in slope at a characteristic laser pulse width, said method comprising the steps of:

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generating at least one laser pulse which has a pulse width equal to or less than said characteristic laser pulse width, said pulse having a width between 10 and 10,000 femtoseconds, and the pulse has an energy of 1 nanojoule to 1 microjoule; and

directing the pulse to a point above the surface of the material.

47 ~~147~~. (Added) A method as in claim ~~146~~ 46, wherein said beam is obtained by chirped pulse amplification (CPA) means comprising means for generating a short optical pulse having a predetermined duration;

means for stretching such optical pulse in time;

means for amplifying such stretched optical pulse including solid state amplifying media; and

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means for recompressing such amplified pulse to its original duration.

48 ~~148~~. (Added) A method for laser induced breakdown (LIB) of a metallic material transparent to radiation with a pulsed laser beam, the material being characterized by a relationship of fluence threshold at which breakdown occurs versus laser pulse width that exhibits a distinct change in slope at a characteristic laser pulse width, said method comprising the steps of:

generating at least one laser pulse which has a pulse width equal to or less than said characteristic laser pulse width, where the laser pulse width is 10 to 10,000 femtoseconds and the laser pulse has an energy of 10 nanojoules to 1 millijoule; and

directing the pulse to a point above the surface of the material.

B1 cont

49 ~~149~~. (Added) A method as in claim 48 ~~148~~, wherein said beam is obtained by chirped pulse amplification (CPA) means comprising means for generating a short optical pulse having a predetermined duration;

means for stretching such optical pulse in time;

means for amplifying such stretched optical pulse including solid state amplifying media; and

means for recompressing such amplified pulse to its original duration.

50 ~~150~~. (Added) A method for laser induced breakdown (LIB) of a metallic material with a pulsed laser beam, the material being characterized by a relationship of fluence threshold at which breakdown occurs versus the square root of laser pulse width that exhibits a distinct change in slope at a characteristic laser pulse width;

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determining the ablation (LIB) threshold of the material as a function of pulse width and determining where the ablation (LIB) threshold function is no longer proportional to the square root of pulse width;

generating at least one laser pulse which has a pulse width equal to or less than the characteristic pulse width; and

directing the pulse to a point above the surface of the material.

51 ~~151~~. (Added) A method of optimally selecting a pulse width and fluence for a pulsed laser beam such that the pulsed laser induces laser induced breakdown (LIB) of a material, the material being characterized by a relationship of fluence threshold at which breakdown occurs versus the square root of laser pulse width comprising the step of identifying where the relationship between fluence threshold and the square root of pulse width exhibits a distinct change in slope and selecting the pulse width and fluence level associated with the distinct change in slope and directing the pulse at a point at or beneath the surface of the material.

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52 ~~152~~. (Added) The method as in claim 51 ~~151~~, wherein the material is non-organic.

53 ~~153~~. (Added) A method as in claim 51 ~~151~~, wherein the material is organic.

54 ~~154~~. (Added) A method for laser induced breakdown of a material with a pulsed laser beam, the material being characterized by a relationship of fluence threshold at which breakdown occurs versus the square root of laser pulse width that exhibits a distinct change in slope at a characteristic pulse width, said method comprising the steps of:

selecting a pulse width and fluence which is equal to or less than the distinct change in slope;

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generating at least one laser pulse which has a pulse width equal to or less than the characteristic laser pulse width and fluence; and

directing said pulse to a point above the surface of a material.

55 ~~155.~~ (Added) The method according to claim ~~124~~ 24, wherein the step of focusing directs the focus of the beam to a point above the surface.

56 ~~156.~~ (Added) The method according to claim ~~133~~ 33, wherein the step of focusing directs the focus of the beam to a point above the surface.

57 ~~157.~~ (Added) The method according to claim ~~135~~ 35, wherein the step of focusing directs the focus of the beam to a point above the surface.

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58 ~~158.~~ (Added) The method according to claim ~~136~~ 36, wherein the step of focusing directs the focus of the beam to a point above the surface.

59 ~~159.~~ (Added) The method according to claim ~~137~~ 37, wherein the step of focusing directs the focus of the beam to a point above the surface.

60 ~~160.~~ (Added) The method according to claim ~~146~~ 46, wherein the step of focusing directs the focus of the beam to a point above the surface.

61 ~~161.~~ (Added) The method according to claim ~~148~~ 48, wherein the step of focusing directs the focus of the beam to a point above the surface.

62 ~~162.~~ (Added) The method according to claim ~~150~~ 50, wherein the step of focusing directs the focus of the beam to a point above the surface.

63 ~~163.~~ (Added) The method according to claim ~~151~~ 51, wherein the step of focusing directs the focus of the beam to a point above the surface.

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64 ~~164~~. (Added) The method according to claim ~~154~~ 54, wherein the step of focusing directs the focus of the beam to a point above the surface.

65 ~~165~~. (Added) The method according to claim ~~124~~ 24, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

66 ~~166~~. (Added) The method according to claim ~~133~~ 33, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

67 ~~167~~. (Added) The method according to claim ~~135~~ 35, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

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68 ~~168~~. (Added) The method according to claim ~~136~~ 36, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

69 ~~169~~. (Added) The method according to claim ~~137~~ 37, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

70 ~~170~~. (Added) The method according to claim ~~146~~ 46, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

71 ~~171~~. (Added) The method according to claim ~~148~~ 48, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

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72 ~~172.~~ (Added) The method according to claim ~~150~~ 50, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

73 ~~173.~~ (Added) The method according to claim ~~151~~ 51, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

74 ~~174.~~ (Added) The method according to claim ~~154~~ 54, wherein the step of directing the pulse at a point above the surface of the material maintains the ablation threshold substantially at the surface of the material.

75 ~~175.~~ (Added) The method according to claim ~~155~~ 55, further including adjusting the intensity of the beam to the minimum necessary for ablation.

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76 ~~176.~~ (Added) The method according to claim ~~156~~ 56, further including adjusting the intensity of the beam to the minimum necessary for ablation.

77 ~~177.~~ (Added) The method according to claim ~~157~~ 57, further including adjusting the intensity of the beam to the minimum necessary for ablation.

78 ~~178.~~ (Added) The method according to claim ~~158~~ 58, further including adjusting the intensity of the beam to the minimum necessary for ablation.

79 ~~179.~~ (Added) The method according to claim ~~159~~ 59, further including adjusting the intensity of the beam to the minimum necessary for ablation.

80 ~~180.~~ (Added) The method according to claim ~~160~~ 60, further including adjusting the intensity of the beam to the minimum necessary for ablation.

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